Claims

1. A method for monitoring a condition of a patient under anesthesia or sedation, the method comprising the steps of:
– acquiring at least a first signal representing a cardiovascular activity of the patient;
– deriving, from said first signal, at least a first and a second parameter value;
– applying a predetermined mathematical index for probability of patient comfort, in which index said at least first and second parameters are variables;
– calculating successively changing values of said mathematical index; and
– indicating said successive index values.

2. A method according to claim 1, wherein said at least first and second parameter values are related to a quantity selected from a group of quantities including waveform amplitudes, waveform periodicity, waveform morphology, and waveform variability.

3. A method according to claim 1, wherein said first signal concerning cardiovascular activity is a blood volume signal measured non-invasively using photoplethysmography.

4. A method according to claim 3, wherein:
– the quantity for said first parameter value is a pulse wave amplitude, or a dicrotic notch height in the pulse wave;
– and the quantity for said second parameter value is a pulse rate, or a heart beat interval, or a temporal position of the dicrotic notch.

5. A method according to claim 1, wherein said first signal concerning cardiovascular activity is blood pressure signal measured using a pressure metering.

6. A method according to claim 5, wherein:
– the quantity for said first parameter value is a systolic, diastolic or mean blood pressure, or a dicrotic notch height in the pulse wave;
– and the quantity for said second parameter value is a pulse rate, or a heart beat interval, or a temporal position of the dicrotic notch.

7. A method according to claim 1, wherein said mathematical index for probability is a nonlinear equation.

8. A method according to claim 1, wherein said mathematical index for probability is a neural network algorithm.

9. A method according to claim 1, wherein said mathematical index for probability is based on a defined or fuzzy rule-based reasoning procedure.

10. A method according to claim 1, further comprising the step of normalizing said first and second parameter values on the basis their respective parameter values acquired over a predetermined fixed time window including or excluding the latest real-time parameter value.

11. A method according to claim 10, wherein said normalized parameter values are acquired from:
– said patient prior to incision, or prior to intubation, or prior to starting anesthesia or sedation, or
– group of patients prior to or during incision and/or intubation and/or anesthesia or sedation.

12. A method for monitoring a condition of a patient under anesthesia or sedation, the method comprising the steps of:
– acquiring at least a first signal and a second signal representing a cardiovascular activity of the patient;
– deriving, from said first signal and second signal, at least a first and a third parameter value;
– applying a predetermined mathematical index for probability of patient comfort, in which index said at least first and third parameters are variables;
– calculating successively changing values of said mathematical index; and
– indicating said successive index values.

13. A method according to claim 12, wherein said at least first and third parameter values are related to a quantity selected from a group of quantities including waveform amplitudes, waveform periodicity, waveform morphology, and waveform variability.

14. A method according to claim 12, wherein said first signal concerning cardiovascular activity is a blood volume signal measured non-invasively using photoplethysmography, or measured using a pressure metering.

15. A method according to claim 14, wherein the quantity for said first parameter value is a pulse wave amplitude, or a systolic, diastolic or mean blood pressure, or a dicrotic notch height in the pulse wave.

16. A method according to claim 12, wherein said second signal concerning cardiovascular activity is a cardiac excitation measured non-invasively using electrocardiogram.

17. A method according to claim 16, wherein the quantity for said third parameter value is a heart rate or inter beat interval of the electrical excitation.

18. A method according to claim 12, wherein said mathematical index for probability is a nonlinear equation.

19. A method according to claim 12, wherein said mathematical index for probability is a neural network algorithm.

20. A method according to claim 12, wherein said mathematical index for probability is based on a defined or fuzzy rule-based reasoning procedure.

21. A method according to claim 12, further comprising the step of normalizing said first and third parameter values on the basis their respective parameter values acquired over a predetermined fixed time window including or excluding the latest real-time parameter value.

22. A method according to claim 21, wherein said normalized parameter values are acquired from:
– said patient prior to incision, or prior to intubation, or prior to starting anesthesia or sedation, or
– group of patients prior to or during incision and/or intubation and/or anesthesia or sedation.

23. A method for monitoring a condition of a patient under anesthesia or sedation, the method comprising the steps of:
– acquiring at least a first signal and a third signal representing a cardiovascular and respectively a combined electrical biopotential on skull activity of the patient;
– deriving, from said first signal, at least a first parameter value;

– calculating, from said third signal, at least a fourth parameter value;
– applying a predetermined mathematical index for probability of patient comfort, in which index said at least first and fourth parameters are variables;
– calculating successively changing values of said mathematical index; and
– indicating said successive index values.

24. A method according to claim 23, wherein at least first parameter value is related to a quantity selected from a group of quantities including waveform amplitude, waveform periodicity, waveform morphology, and waveform variability.

25. A method according to claim 23, wherein said at least fourth parameter value related to a quantity selected from a group of quantities including energy, power, signal complexity and frequency content, each over a predetermined time period.

26. A method according to claim 23, wherein said first signal concerning cardiovascular activity is a blood volume signal measured non-invasively using photoplethysmography.

27. A method according to claim 26, wherein:
– the quantity for said first parameter value is a pulse wave amplitude, or a dicrotic notch height in the pulse wave;
– and the quantity for said second parameter value is a pulse rate, or a heart beat interval, or a temporal position of the dicrotic notch.

28. A method according to claim 23, wherein said third signal is a non-invasive measurement concerning neuromuscular and brain activity.

29. A method according to claim 28, wherein said neuromuscular and brain activity measurement comprises electromyography and electroencephalogram.

30. A method according to claim 29, further comprising the step of extracting electric myographic component from said third signal as an EMG partial signal, and electroencephalographic component as an EEG partial signal.

31. A method according to claim 30, wherein the quantity for said fourth parameter value is a spectral power calculated from said EMG partial signal.

32. A method according to claim 29 and 30, wherein the quantity for said fourth parameter value is a subtraction of a response entropy, calculated from said third signal as a whole, and a state entropy, calculated from said EEG partial signal.

33. A method according to claim 23, wherein said first signal concerning cardiovascular activity is a cardiac excitation measured non-invasively using electrocardiogram.

34. A method according to claim 33, wherein the quantity for said first parameter value is a heart rate or inter beat interval of the electrical excitation.

35. A method according to claim 23, further comprising the steps of:
– acquiring online a second signal representing a cardiovascular activity of the patient;
– deriving, from said and second signal, a third parameter value related to a quantity selected from a group of quantities including waveform amplitudes, waveform periodicity, waveform morphology, and waveform variability; and
– introducing said at least third parameter in said predetermined mathematical index as an additional variable.

36. A method according to claim 35, wherein the quantity for said first parameter value is a heart rate or inter beat interval of the electrical excitation.

37. A method according to claim 23, wherein said mathematical index for probability is a nonlinear equation.

38. A method according to claim 23, wherein said mathematical index for probability is a neural network algorithm.

39. A method according to claim 23, wherein said mathematical index for probability is based on a defined or fuzzy rule-based reasoning procedure.

40. A method according to claim 23, further comprising the step of normalizing said first and fourth parameter values on the basis their respective parameter values acquired over a predetermined fixed time window including or excluding the latest real-time parameter value.

41. A method according to claim 40, wherein said normalized parameter values are acquired from:
– said patient prior to incision, or prior to intubation, or prior to starting anesthesia or sedation, or
– group of patients prior to or during incision and/or intubation and/or anesthesia or sedation.

42. An apparatus for monitoring a condition of a patient under anesthesia or sedation, the apparatus comprising:
– at least first sensor means for receiving electrical signal representing a cardiovascular activity of the patient;
– first time measuring means and a first voltage/current dependent circuit connected with said sensor means;
– first memory means storing criteria of predetermined pulse wave parameters to be extracted from said signal;
– first deriving means connected to said first memory means, said first time measuring means and said first voltage/current dependent circuit for extracting first and second values of said predefined pulse wave parameters;
– second calculation means for successively performing a predetermined mathematical program having temporally variable mathematical index values for probability of patient comfort, based on said first and second pulse wave parameter values, as an output; and
– a display and/or connections into further devices.

43. An apparatus according to claim 42, further comprising second memory means for storing pulse wave parameter values acquired prior to said receiving of said electrical signals.

44. An apparatus according to claim 42, wherein said first sensor means is a photoplethysmography unit, or a pressure transducer unit.

45. An apparatus for monitoring a condition of a patient under anesthesia or sedation, the apparatus comprising:
– at least first and second sensor means for receiving electrical signals representing a cardiovascular activity of the patient;
– first and second time measuring means and a first and second voltage/current dependent circuit connected with said sensor means;

– first memory means storing criteria of predetermined pulse wave parameters to be extracted from said signals;
– first deriving means connected to said first memory means, said first time measuring means and said first voltage/current dependent circuit for extracting first values of said predefined pulse wave parameters;
– second deriving means connected to said first memory means, said second time measuring means and said second voltage/current dependent circuit for extracting third values of said predefined pulse wave parameters;
– second calculation means for successively performing a predetermined mathematical program having temporally variable mathematical index values for probability of patient comfort, based on said first and third pulse wave parameter values, as an output; and
– a display and/or connections into further devices.

46. An apparatus according to claim 45, further comprising second memory means for storing pulse wave parameter values acquired prior to said receiving of said electrical signals.

47. An apparatus according to claim 45, wherein said first sensor means is a photoplethysmography unit, or a pressure transducer unit.

48. An apparatus according to claim 45, wherein said second sensor means is an electrocardiography unit.

49. An apparatus for monitoring a condition of a patient under anesthesia or sedation, the apparatus comprising:
– at least first and third sensor means for receiving electrical signals representing a cardiovascular and respectively an electrical biopotential on skull activity of the patient;
– second and third time measuring means and a second and third voltage/current dependent circuit connected with said sensor means;
– first memory means storing criteria of predetermined parameters to be extracted from said signals;
– first deriving means connected to said first memory means, said first time measuring means and said first voltage/current dependent circuit for extracting first values of predetermined pulse wave parameters;

– first calculation means connected to said first memory means, said third time measuring means and said third voltage/current dependent circuit for extracting fourth values of predetermined biopotential parameters;
– second calculation means for successively performing a predetermined mathematical program having temporally variable mathematical index values for probability of patient comfort, based on said first and fourth parameter values, as an output; and
– a display and/or connections into further devices.

50. An apparatus according to claim 49, further comprising second memory means for storing pulse wave parameter values acquired prior to said receiving of said electrical signals.

51. An apparatus according to claim 49, wherein said first sensor means is a photoplethysmography unit, or a pressure transducer unit.

52. An apparatus according to claim 49, wherein said third sensor means is an electromyography–electroencephalography unit.

53. An apparatus according to claim 52, further comprising a frequency dependent circuit for separating the electromyography portion and the electroencephalography portion of said signal from the third sensor means.